draft

Concept Paper
Rainwater Harvesting and Recharge System

Background: Typical rainwater harvesting systems capture precipitation from rooftops and store it in a reservoir or cistern. The stored water is then used during the dry season by pumping it, carrying it by hand, or gravity flow to apply it to outdoor landscaping in order to reduce demand for potable water. However, most of the available rainwater is lost due to insufficient storage capacity. This concept paper proposes a lower cost solution to increase rainwater harvesting efficiency.

Typical rainwater harvesting system characteristics:

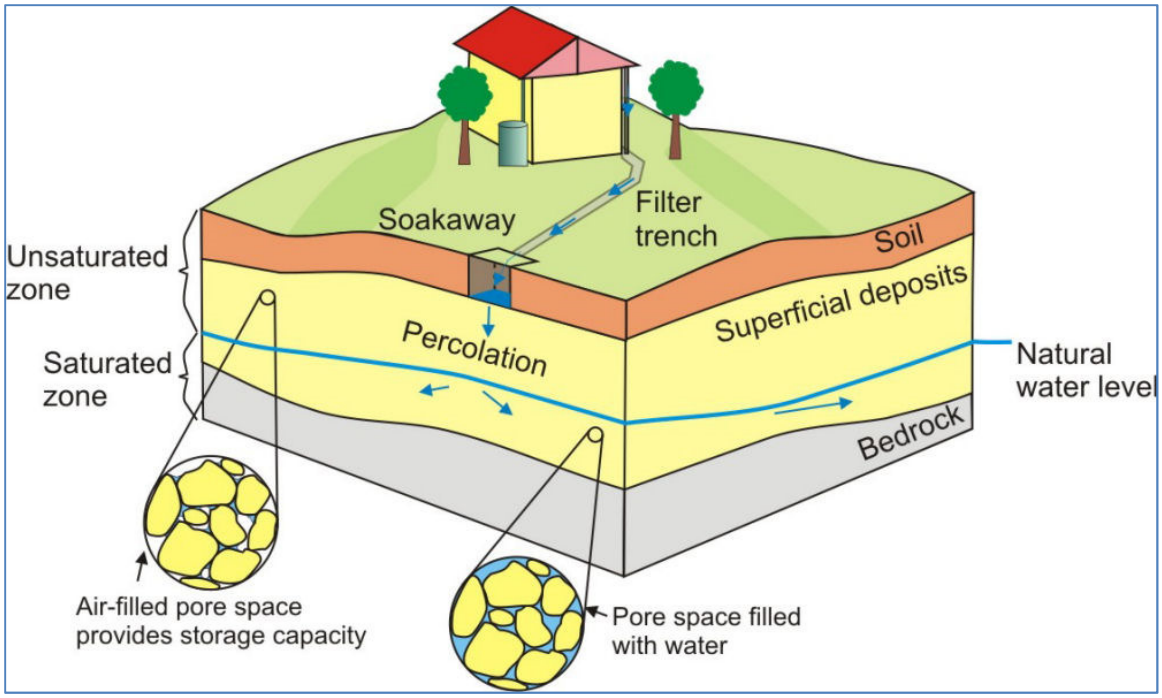
1. An efficient system is expensive. A large reservoir is required to maximize use of the available rainwater. For Central Yavapai County, rainwater collected during the (typically) wet months such as November through April would be used to meet landscaping water needs in May and June. A 2008 water conservation study (Regional Water Conservation Program Development and Recommended Implementation Plan, Larson and Associates, September 2008) concluded that a 2,875 gallon storage tank with a pumping and filtration system would cost $7,500.
2. Much of the potentially available rainwater is lost due to lack of storage capacity. In the example above (using a 2,500 square-foot roof area and an average of 8.5 inches of seasonal precipitation from November through April in Prescott) approximately 13,200 gallons of rainwater could be captured. The 2,875 gallon storage system is capable of storing only 22% of the available supply.
3. Typical rainwater harvesting systems may create an incentive for owners to install additional plants in their landscaping because of the perception of "free" water. This may actually drive up demand for potable water during times when the rainwater harvesting system runs dry.
4. Typical rainwater harvesting systems are often complex, incorporating pumps, filtration systems and backflow prevention devices – effectively creating a separate water system that needs to be maintained.
5. Water storage tanks are a potential breeding ground for mosquitos and must be managed to prevent algae growth.

Another alternative is available that is less expensive and more efficient at collecting rainwater. To capture all of the available rainwater simply recharge the aquifer rather than consume it on landscaping. This concept can extend the useable life of private wells. Instead of constructing an expensive storage reservoir, a simple French drain (AKA "soakaway pit") is installed on the well owner's property and plumbed directly to the rooftop gutter system. There are several advantages to this type of system:

1. The storage capacity of the system can be smaller than the typical rainwater harvesting system since it is designed to drain into lower stratum (vadose zone) between precipitation events. The storage capacity need only be large enough to capture rain from one storm, not a full season of storms.
2. Costs are about 1/3 of the typical system with a large storage tank.
3. Less operational knowledge is required and maintenance costs are minimal.
4. All of the harvested rainwater is put back into the aquifer to benefit the well. The harvested yield is much higher than for most rainwater harvesting systems.
5. The landowner operates one water system so there is no need for filtration systems, algae abatement, pumps and separate pipes for managing rainwater collected in a cistern. The water source for landscaping and other needs still comes from the well.
6. No opportunity for mosquito breeding since the system drains within a day or two.
7. Once installed, the property above the drains can be used for parking, etc.

Policy/institutional issues related to these systems:

1. Registration of the system with ADEQ is likely required under the dry well registration program. Registration fees are $100.00.
2. Under the dry well registration program, there appears to be a setback requirement from groundwater wells of 100-feet. This requirement may limit the application and effectiveness of these systems.
3. The landowner would not need to obtain an Aquifer Protection Permit unless other storm water sources were introduced.
4. Installation of rainwater capture systems could become a requirement for obtaining a permit to install a private well. This would offset aquifer impacts from private wells.
5. The systems may not be applicable to all areas such as locations with impermeable strata, or properties that are too small to construct the French drain.
6. Deep rooted plants would need to be planted some distance away from the system.



Project Outline

- Install one or more pilot rainwater harvesting – aquifer recharge projects
    - Determine system costs and benefits
    - Outline system requirements
        - Soil types
        - Aquifer characteristics
        - Seasonal and annual precipitation patterns
        - Gutter and plumbing design requirements
        - French drain design requirements
        - Possible incorporation with a septic system and leech field
- Using GIS layers:
    - Soil drainage characteristics
    - Precipitation amounts
    - Known aquifer boundaries
- Determine policy/legal barriers and requirements
    - Existing permit requirements for installation,
    - Any necessary changes to facilitate installation
    - Possible Incentives, such as:
        - Reduced development impact fees
        - Quicker, easier approval of building permit
        - Cheaper well permit
        - Incorporate into Low Impact Development Guidelines
- Incorporate into Virtual RW Harvesting Website

Cost Estimate Example for a Small Scale French Drain for Rainwater Harvesting and Aquifer Recharge (does not include cost of rooftop gutters, downspouts and conveyance to the French Drain)

Design Criteria: Capture, store and recharge rainwater.

- 2,500 square-foot roof, 1 inch rainfall in 1 hour.
- Total Water Capture = 208 ft^3 or 1,558 gallons
- Assume pore space of ¾" gravel is 38% by volume
- Need 140 feet of trench, 2 feet wide filled with 2 feet of gravel to store 208 ft^3 of water
- Install 3" PVC corrugated drainage pipe in top 6" of gravel with 3" of cover and geotextile
- Back fill top 3 feet with excavated material (3-foot depth will locate gravel and drain below typical rooting depth of grasses. Trees and shrubs should be kept away.)
- Drains should be at least 10 feet away from foundations
- French Drains should not compete with leach fields
- French Drains in soils with poor drainage characteristics may need to be upsized

Cost Estimates Rooftop Rainwater Harvesting/Recharge
(2,500 ft^2 Roof captures 1" rain in 1 hour)

Description	Quantity	Units	Unit Cost	Cost
Excavation	52	Cu Yards	$ 15.75	$ 819
Haul off-site	21	Cu Yards	$ 20.00	$ 420
3/4+ Gravel Delivered	21	Cu Yards	$ 30.00	$ 630
Back fill 3/4+ Gravel	21	Cu Yards	$ 7.00	$ 147
Back fill excavated material	31	Cu Yards	$ 7.00	$ 217
3" PVC drainage pipe	180	feet	$ 0.62	$ 112
Geotextile	32	Sq Yards	$ 0.26	$ 8
NDS Catch Basin	2	each	$ 51.36	$ 103
Labor	8	hours	$ 15.00	$ 120
Total				$ 2,576